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# NASA TECH BRIEF

*Lewis Research Center*



## Noncontaminating Technique for Making Holes in Existing Process Systems

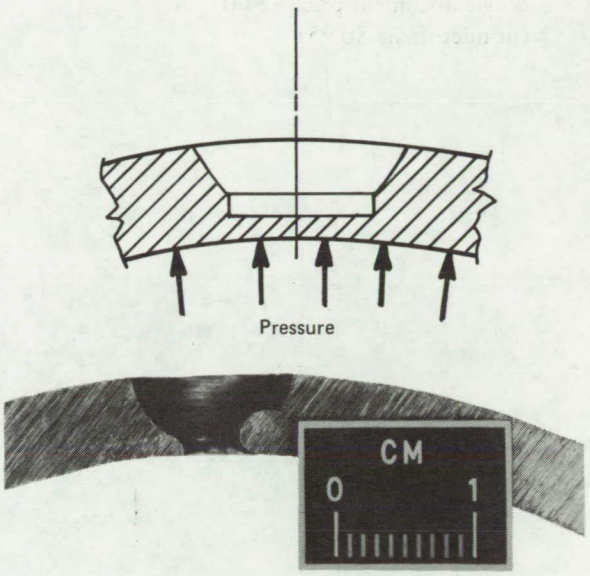
A technique has been developed for making cleanly-contoured holes in assembled process systems without introducing chips or other contaminants into the system. Such holes are often required for instrumentation ports, bypass lines, sampling station lines, and system observation holes. This technique uses portable equipment and does not require dismantling the system.

Normally, making access holes in process piping involves removing sections of the system. The holes are drilled, and the section cleaned and reinstalled in the system. Since this method involves disassembly and reassembly, the system must usually be retested for leaks.

In this new technique, a blind pilot hole is drilled part way through the piping or vessel wall, the system is pressurized with an inert gas to a pressure of approximately 7.5 to 13-cm of water (3 to 5 inches), the hole is completed by heating with a welder to melt the remaining wall material, and the molten metal is pushed outward by the pressure in the system.

The blind pilot hole is drilled with a hand-held electric drill to within 0.127 to 0.152-cm (0.050 to 0.060 inch) of the inner wall. This remaining metal thickness was chosen as the minimum allowable as a safety factor to prevent breaking through the pipe wall during the drilling process. The pilot hole is then flat-bottomed with either an end mill or a bottoming drill. The pilot hole is then countersunk with a ball-type rotary file to form an area for the metal to flow into during the melting process. A cross-sectioned drawing of a typical blind pilot hole is shown in Figure 1. Holes up to 0.635-cm (0.250-inch) diameter have been made with a 0.95-cm (3/8-inch) diameter pilot hole and a 1.59-cm (5/8-inch) diameter rotary file as the countersink.

The hole is completed by pressurizing the closed-loop system to 12.7 -cm (5 inches) of water and melting through the remaining metal thickness with a welding machine. The completed hole is usually small initially, and can be increased in size by additional melting (aftermelt). For the aftermelt phase, internal pressure is maintained at one inch of water to keep the metal flowing toward the outside of the pipe. Figure 2 is a photograph of the cross section of a hole in 0.25-inch thick Inconel tube. As can be seen from the photo, all the metal from the bottom of the pilot hole flowed to the countersunk area. There was no buildup of metal on the inside of the tube, and no contaminants were found inside the test section.




On pipes having wall thickness around 0.127 to 0.152 cm (0.050 to 0.060 inch), no pilot hole is drilled and no aftermelt is performed. The hole size is determined by the pressure on the inside of the pipe during the melting phase. A pressure of 5-cm (2 inches) of water results in about a 1.27-cm (½-inch) diameter hole. A pressure of 7.5 cm (3 inches) of water results in about a 0.95-cm (3/8-inch) diameter hole. For these thin-walled pipes,

(continued overleaf)

the arc of the welding machine is struck on the pipe wall and moved around the desired area at a low-heat level. After about four seconds, the heat is increased to a high level, thus forming the hole.

This hole-making technique was tested in all positions to study the effect of gravity. The technique worked well in all positions. This method has been tested on Inconel, stainless steel, ASTMA-53 steel, and Hastelloy X.

## Notes:

1. The following documentation may be obtained from:
   National Technical Information Service
   Springfield, Virginia 22151
   Single document price $3.00
   (or microfiche $0.95)
   Reference: NASA TM-X-2431 (N72-11484), A Technique for Making Clean Holes in Metallic Piping and Components
2. Technical questions may be directed to:
   Technology Utilization Officer
   Lewis Research Center
   21000 Brookpark Road
   Cleveland, Ohio 44135
   Reference: B72-10385

## Patent status:

No patent action is contemplated by NASA.

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